Nematics Confined by Competing Walls

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The consequences of confinement on the isotropic-nematic transition are investigated for a slab geometry with walls that compete in molecular alignment. We employ the Landau-de Gennes free energy with wall fields that favor random parallel and homeotropic orientations, respectively. The differences in phase behavior with respect to the bulk, or with respect to the system confined by identical walls, are significant: depending on the wall separation L and the strength of the wall fields μ_0 , the isotropic-nematic (IN) transition is either unaffected and its temperature T_{IN} remains fixed, or, the transition disappears altogether. We find: i) when $\mu_0 < \mu_o^w$ (where μ_o^w is the wall field value for the wetting transition of the semi-infinite system) the transition occurs for all wall separations, and ii) when $\mu_0 > \mu_o^w$ there is no transition for all wall separations above a given value $L_0(\mu_0)$. The boundary $L_0(\mu_0)$ between these two regions is identified as a shifted wetting transition in which NI phase coexistence is transformed into an interface-like state, and it is of the 1st order, tricritical and critical when $\mu_o^w < \mu_0 < \mu_o^{tc}$, $\mu_0 = \mu_o^{tc}$ and $\mu_0 < \mu_o^{tc}$, respectively. For temperatures in the neighborhood of T_{IN} , $L_0(\mu_0)$ is continued as a locus of shifted prewetting transitions. This behavior is equivalent, but manifests differently, to that already known for a magnetic slab under opposing surface fields and vanishing coupling surface enhancement.